DOCUMENT RESUME

ED 249 042 SE 044 883

AUTHOR Leedy, Daniel L.; Adams, Lowell W.
TITLE A Guide to Urban Wildlife Management.
INSTITUTION National Inst. for Urban Wildlife, Columbia, MD.
PUB DATE 84
NOTE 48p.
AVAILABLE FROM National Institute for Urban Wildlife, 10921 Trotting Ridge Way, Columbia, MD 21044.
PUB TYPE Guides - General (050)

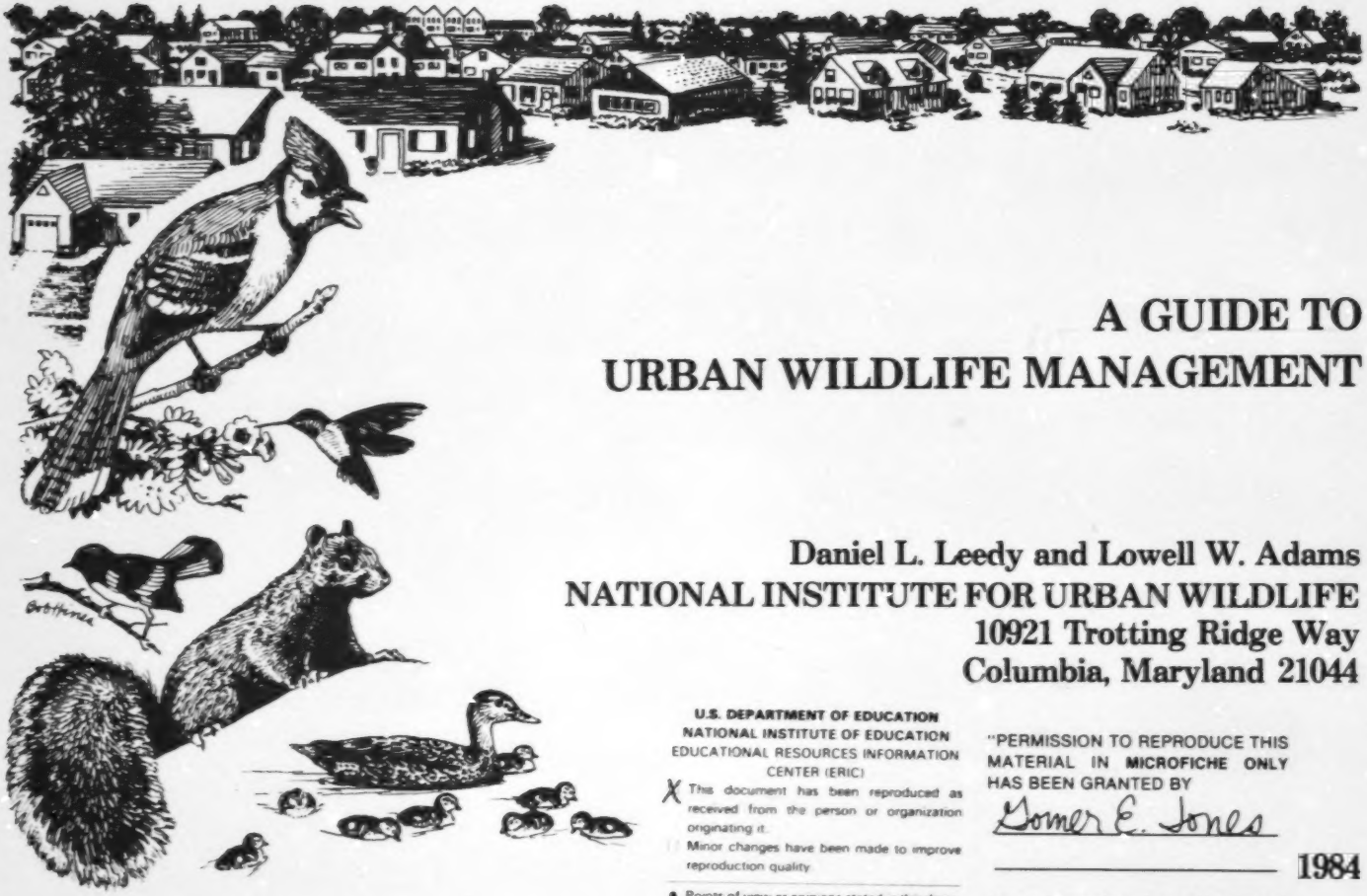
EDRS PRICE MF01 Plus Postage. PC Not Available from EDRS.
DESCRIPTORS *Animals; Conservation (Environment); Conservation Education; Environmental Education; *Environmental Influences; Physical Environment; Public Opinion; *Urban Areas; *Urbanization; *Wildlife; *Wildlife Management

ABSTRACT

This guide is designed to provide interested citizens (including homeowners, youths, and community leaders) with guidance and ideas on how to plan and manage for urban and suburban wildlife. In addition, it suggests how to enhance recreational, aesthetic, educational, and economic benefits associated with good diversified habitats and sound fish and wildlife management. Following an introduction, the guide is divided into sections which discuss: (1) values and public attitudes related to urban wildlife; (2) wildlife habitats and environments (considering the role of plants as food and cover sources, water, living space, and mortality factors); (3) urbanization effects (examining pollution and urbanization effects on temperature and rainfall, vegetation, and on soil and water); (4) response of wildlife to urbanization; and (5) principles and approaches to wildlife management (considering separately, principles, approaches to wildlife management, habitat management for fish and wildlife, management to promote educational and recreational values, and animal damage and nuisance control). The guide concludes with a list of suggestions for promoting conservation and enhancing wildlife enjoyment and a list of suggested readings and references. (JN)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

ED249042



A GUIDE TO URBAN WILDLIFE MANAGEMENT

Daniel L. Leedy and Lowell W. Adams
NATIONAL INSTITUTE FOR URBAN WILDLIFE
10921 Trotting Ridge Way
Columbia, Maryland 21044

U.S. DEPARTMENT OF EDUCATION
NATIONAL INSTITUTE OF EDUCATION
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

X This document has been reproduced as received from the person or organization originating it.

☐ Minor changes have been made to improve reproduction quality.

• Points of view or opinions stated in this document do not necessarily represent official NIE position or policy.

"PERMISSION TO REPRODUCE THIS MATERIAL IN MICROFICHE ONLY HAS BEEN GRANTED BY

Gomer E. Jones

1984

TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)."

PE 044883

Leedy, Daniel L. and Lowell W. Adams. 1984. A Guide to Urban Wildlife Management. National Institute for Urban Wildlife, 10921 Trotting Ridge Way, Columbia, Maryland 21044. 42 pp.

© MCMLXXXIV National Institute for Urban Wildlife

A GUIDE TO URBAN WILDLIFE MANAGEMENT

Prepared by
Daniel L. Leedy and Lowell W. Adams
National Institute for Urban Wildlife
10921 Trotting Ridge Way
Columbia, Maryland 21044

in cooperation with
The U.S.D.A. Forest Service, Forest-Resource Management
370 Reed Road, Broomall, Pennsylvania 19008

and

The U.S.D.I. Fish and Wildlife Service, Office of
Extension and Publications
Washington, D.C. 20240

PREFACE AND ACKNOWLEDGMENTS

This guide was prepared by the National Institute for Urban Wildlife with advice and encouragement from the U.S. Forest Service and the U.S. Fish and Wildlife Service. Its primary purposes are: (1) to provide interested citizens, including individual homeowners, youths, and community leaders with guidance and ideas on how to plan and manage for urban and suburban wildlife; and (2) to suggest how to enhance recreational, aesthetic, educational, and economic benefits associated with good diversified habitats and sound fish and wildlife management.

Approximately three-fourths of U.S. citizens live in urban-suburban areas and the numbers of Americans living in such areas is still growing. Employment opportunities, transportation facilities, energy costs, conveniences of city living, and the desire of most people to live near other people probably ensure that the majority of our citizens will continue to live in these areas. However, many urban-suburban residents feel the need for communing with nature close at hand and appreciate a natural setting in which wildlife is an important part. An understanding and appreciation of wildife and ecological relationships can be gained in one's own backyard or urban-suburban community. This understanding is helpful in promoting intelligent voting and support of legislative issues concerned with environmental problems in rural and wilderness areas as well as in local developed areas.

Although this guide focuses primarily on management and appreciation of fish and wildlife in suburban and urban northeastern United States, the procedures and principles set forth are generally applicable elsewhere.

Many individuals assisted with the initiation and preparation of this report. Thomas M. Franklin, former Executive Director of the Urban Wildlife Research Center (now National Institute for Urban Wildlife) made the initial contacts with the cooperating agencies. Richard R. Roth and Clyde M. Hunt of the U.S. Forest Service, and Daniel Stiles and Duncan MacDonald of the U.S. Fish and Wildlife Service made many helpful suggestions. Bob Hines and Jacqui Schulz prepared the sketches for illustrating the guide. Though not referred to specifically in the text, several publications from which information or ideas were extracted and others useful to readers wishing more information are listed under Suggested Readings and References.

TABLE OF CONTENTS

PREFACE AND ACKNOWLEDGMENTS ii
INTRODUCTION 2
URBAN WILDLIFE: VALUES AND PUBLIC ATTITUDES 5
WILDLIFE HABITATS AND ENVIRONMENTS 8
- Food and Cover: The Importance of Plants 10
- Water 15
- Living Space 15
- Mortality Factors 15

URBANIZATION EFFECTS 17
- Effects on Temperature and Rainfall 17
- Effects on Vegetation 17
- Effects on Soil and Water 18
- Pollution 19
- Other Effects 22

RESPONSE OF WILDLIFE TO URBANIZATION 23
WILDLIFE MANAGEMENT: PRINCIPLES AND APPROACHES 26
- Principles 26
- Approaches to Wildlife Management 27
- Habitat Management for Fish and Wildlife 28
- Management to Promote Educational and Recreational Values 32
- Animal Damage and Nuisance Control Considerations 35

OTHER SUGGESTIONS FOR PROMOTING CONSERVATION AND ENHANCING WILDLIFE ENJOYMENT 38
SUGGESTED READINGS AND REFERENCES 41

INTRODUCTION

When the "founding fathers" began arriving in this country, most of the land from the Atlantic Ocean inland to the Appalachian Mountains was forested. The settlers cut and burned much of the forest for agriculture and, for several decades, the majority of the human population in the Northeast was rural. Only 100 years ago, nearly three-fourths of the State of Massachusetts was cleared and farmed; now only about one-fourth of the area is farmland, the remainder having reverted to forest or used for urban and other developments. There are many suburban homes in forested areas amongst the trees. Similar patterns exist in much of the Northeast.

Some wildlife species, like the cougar or mountain lion, beaver, white-tailed deer, and wild turkey, were eliminated or greatly reduced with the decimation of the forests. Other species, like the bobwhite quail, increased with the presence of crop fields and fencerows. In time much farmland no longer economically suitable for agriculture was abandoned, and brush and trees again covered the land through a process called natural succession. With these changes in land use and vegetation, deer, beaver, ruffed grouse, and other woodland species flourished once again.

Meanwhile, towns and cities developed and expanded. As agricultural practices were modernized and transportation facilities were improved, fewer farmers were required to produce food for a growing human population. Currently, only about 3% of our residents, nationwide, are farmers. Flying on a clear night from Portland, Maine to Baltimore, Washington, D.C., or Richmond, Virginia, one is impressed by the seemingly uninterrupted city, suburb, town, and village lights shining below—evidence of extensive urbanization in the Northeast. Yet, sufficient wooded areas and fields remain to support healthy populations of many kinds of wildlife.

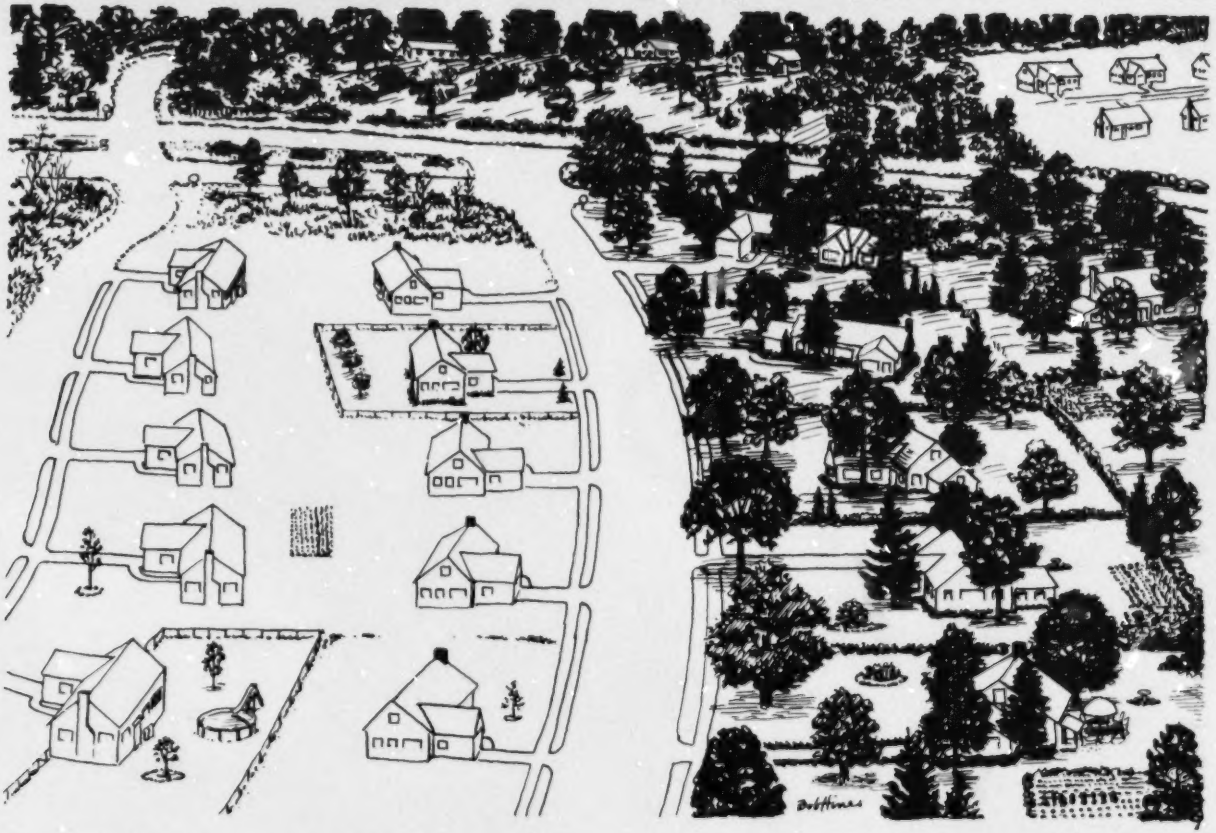
Although many people think that the only urban animals are house mice, Norway rats, house sparrows, pigeons, and starlings, many of our native wildlife species found in the forests, fields, and marshes of the Northeast also occur in urban and suburban areas. Wildlife is an important part of our developed suburban environment, just as it is in rural areas where many of the game birds and mammals are hunted for sport, or where species like muskrat and beaver are trapped for their fur. Wildlife, i.e., wild animals with "backbones" (including fish) and invertebrates, like earthworms, crayfish, dragonflies, and butterflies are considered "urban wildlife" when found in urban areas.

There is a general impression that once a forested or agricultural area is urbanized or developed for industry, airports, or other uses, it loses its value as wildlife habitat. While such developments modify up to a million acres of agricultural and forest land annually, they need *not* destroy all of the wildlife habitat values of the land. This is especially true in planned new cities like Columbia, Maryland, in suburban areas where considerable vegetated open space is maintained, and in city parks. With proper management, even more wildlife can be accommodated, not only in community-owned areas, but in residents' backyards.

In cities, suburbs, and villages residents can enjoy wildlife in a non-consumptive way and learn to understand some of the interactions of wildlife with the environment. This guide discusses why wild animals often find our parks, open space areas, gardens, and yards attractive, and suggests ways of making these areas even more attractive. While the guide emphasizes the positive aspects of urban wildlife, it also suggests ways of dealing with animal damage or nuisance problems. Those homeowners who may wish to discourage wildlife should make their yards less attractive or exclude animals by fencing, screening, etc. Most residents, however, like to see wildlife around their homes and are willing to put up with limited animal damage or nuisance which can often be controlled without discouraging desirable wildlife.

Urban development need not destroy all of the wildlife habitat values of the land.

In some situations, as in a vegetable garden, the old adage about planting corn may be applicable: "Plant one [kernel] for the mold, one for the crow, and one to grow." If this approach were taken, we believe that by planting a surplus of attractive plants, we would be sharing the abundance with our wildlife friends, rather than competing with them.



Prospective home buyers might well encourage developers and builders to leave standing as much as possible of the existing vegetation rather than completely clearing an area, as was done in the community on the left. With some care, many large trees, along with native shrubs and ground cover valuable for wildlife, could be saved, thus reducing time and money spent in landscaping a new community.

URBAN WILDLIFE: VALUES AND PUBLIC ATTITUDES

Many studies show that the public places a high value on fish and wildlife for recreation and other reasons. A 1980 national survey conducted by the U.S. Department of the Interior, Fish and Wildlife Service, and the U.S. Department of Commerce, Bureau of the Census, indicated that wildlife-associated recreation is very popular. Some 19.4 million people engaged in hunting, 53.9 million in sport fishing, and 94.6 million in non-consumptive activities, like observing, feeding, or photographing wildlife. Nearly 80 million of the latter observed, photographed, or fed wildlife at home. The survey indicated that nearly 4.5 million New England residents and about 9.9 million Middle Atlantic residents observed and/or photographed wildlife, and in these same regions, some 5.4 and 13.0 million residents, respectively, fed birds and other wildlife.

Many studies show that the public places a high value on fish and wildlife for recreation and other reasons.

Despite these findings, other studies, including one sponsored by the U.S. Fish and Wildlife Service, show that the American public as a whole has an extremely limited knowledge of animals. This appears to be especially true of residents of large cities, those people over 75 or under 25 years of age, and those with less than a high school education. A survey conducted in Guelph, Ontario revealed that most residents were unable to name individual wildlife species, including invertebrates, reptiles, and amphibians as wildlife, and could not relate habitat conditions to the wildlife they observed. However, nearly half of the people contacted were willing to subsidize wildlife conservation in the city by means of a special municipal tax. As true in the United States, few Guelph residents knew the federal or provincial (our state) agencies responsible for wildlife management, and most learned about wildlife from television. But progress is being made with respect to the public's understanding and appreciation of wildlife. With the help of professional wildlife managers, urban and

suburban residents can learn how to better manage and enjoy wildlife

With the help of professional wildlife managers, urban and suburban residents can learn how to better manage and enjoy wildlife.

A U.S. Forest Service study published in 1973 revealed that 43% of the residents of Amherst, Massachusetts regularly fed birds at an average annual cost, at that time, of $8.80 for bird feed. An independent market research agency determined that 23.8% of Boston's 800,000 plus households reported feeding birds at a similar average yearly cost of $8.20.

Colorful butterflies and birds like cardinals, tanagers, bluejays, and goldfinches brighten the urban setting, as do trees and flowering shrubs which are such an important part of wildlife habitat. A researcher in Amherst, Massachusetts found that trees around a house have a tangible effect on its marketability, enhancing the property value by as much as 20%. In 1975, one urban forester estimated that, in the aggregate, the value of publicly owned trees in a typical city of about 200,000 inhabitants in New York State was over $200,000. The number of publicly owned trees was not stated, but when privately owned trees in homeowners' lawns are added, the monetary value of trees becomes very large. The monetary value of trees decreases as one travels away from cities but their value to wildlife remains high.

In Columbia, Maryland, some residents who enjoyed seeing

Flower gardens, beautiful in their own right, attract colorful butterflies. Gardening for butterflies can be as interesting as gardening for birds.

waterfowl and other wildlife in stormwater retention ponds near their homes objected to eliminating those ponds scheduled for removal after construction of the housing development was completed. In responding to a 1982 questionnaire survey, 94% of the residents agreed that it would be desirable, when feasible from engineering and economic standpoints, to design and manage future stormwater control basins for fish and wildlife as well as for flood and sediment control. Also, 75% of the homeowners felt that permanent bodies of water added to real estate values and 73% said they would pay more for property located in a neighborhood having permanent water basins designed to enhance fish and wildlife use.

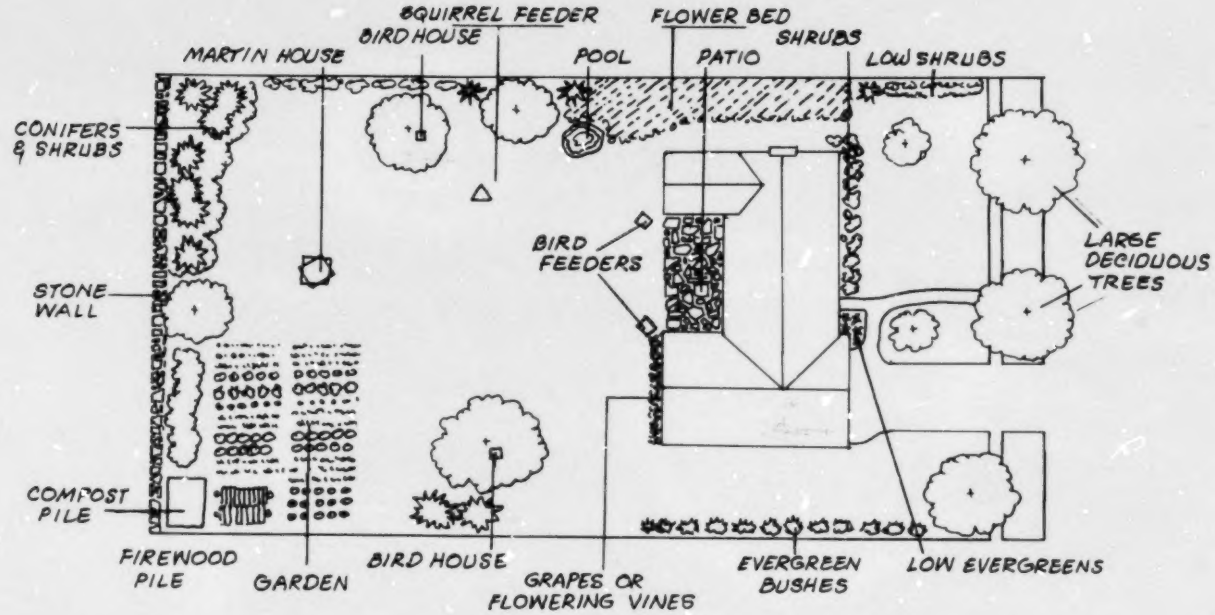
No completely satisfactory way of determining the economic and other values of urban wildlife has been devised. However, annual expenses for bird feed, bird feeders and houses, binoculars, photographic equipment, and supplies used in observing and enjoying urban wildlife amount to many hundreds of millions of dollars, nationally. Ideally, an evaluation method would provide for balancing the positive values of wildlife, like the consumption of mosquito and garden insect pests by certain fish and insect-eating birds, with negative aspects, such as the property damage or nuisances caused by some wild animals.

Also, the values of wildlife and wildlife habitat for educational and scientific purposes, and for one's general development and well-being, must not be overlooked. One investigator suggested that people born and reared in diversified back-country areas have more acute vision than urban residents who have been constantly exposed to a visual clutter dominated by the vertical and horizontal lines of buildings. He considered it important that children be exposed to natural environments during their formative years to create a citizenry more responsive to the need for, and more capable of participating in, intelligent decision making on conservation matters.

WILDLIFE HABITATS AND ENVIRONMENTS

To survive, all animals must have food, water, cover, and a place to live and reproduce. The place where an animal or plant grows is called "habitat." Good habitat provides all of these requirements for sustaining wildlife populations. Man-made structures, like buildings and bridges, are a part of the habitat for some urban wildlife species in that they provide cover and a place for the animals to live and reproduce. In some situations, they may be a source of food, too.

Over time, habitats of fish and wildlife are subject to change, whether by natural forces such as floods, fires, volcanic eruptions, earthquakes, windstorms, disease and insects, or by man's activities. *Any* change in the environment, whether natural or man-caused, affects wildlife. A beneficial change for one species may be detrimental for others. Effects on wildlife depend primarily on changes in the quality and availability of food, water, cover, and living space.



Sketch (vertical view) of a possible arrangement to provide the essentials for wildlife—cover, food, space, and water—on a residential lot. A mixture of deciduous and evergreen species of trees and shrubs with varying periods of flowering and fruit retention is recommended.

FOOD AND COVER: THE IMPORTANCE OF PLANTS

Plants, especially trees and shrubs in the Northeast, provide both food and cover for wildlife. Their fruits, nuts, bark, foliage, and sometimes roots, are consumed by various animals. Tree cavities formed through natural decay processes or created by woodpeckers and other animals serve as dens or nesting sites for squirrels, raccoons, and many bird species. Leaves and bark are used for nest building by squirrels and birds. Insects found on foliage, bark, or dead wood of trees are eaten by warblers, woodpeckers, and other insect-eating birds. Trees, especially those with dead tops or limbs, are favorite perching sites for hawks and other raptors which feed on mice or other small mammals on the ground below.

Green plants—whether in water or on land—contain a substance called chlorophyll and are able to use water from the soil and carbon dioxide from the air in the presence of sunlight to create sugar. This process is called photosynthesis. Through further chemical changes taking place in the plants or in animals that eat plants, this basic sugar is converted into more complex carbohydrates, proteins, fats, and other substances that support life.

Plants, therefore, are food machines without which wildlife and humans could not live. Also, oxygen, a by-product of photosynthesis, is necessary for nearly all plants and animals. Plants are at the base of food chains or food webs which may be very complex. Algae in a pond may be eaten by tiny crustaceans, which, in turn may be eaten by small fish, which are eaten by larger fish, which may be eaten by an osprey or bald eagle at the top of the food chain. On land, grasshoppers, crickets, beetles, or rabbits which feed on vegetation may provide food for red foxes.

When a tree or other plant dies, many types of decomposer organisms like microscopic bacteria, fungi, earthworms, mites, millipedes, and springtails live on the dead material and cause its breakdown and decomposition. Basic chemical elements, including carbon, hydrogen, oxygen, nitrogen, iron. and calcium, are thus recycled, with the result that most elements in our own bodies were once parts of other living things. A hollow tree lying on the ground may provide a hiding place for a cottontail rabbit or raccoon and, frequently, red-backed salamanders are found in or under old stumps and logs. A tree trunk or limb lying partially submerged in a pond or river provides cover for fish, attachment sites for various aquatic insects, and resting or sunning sites for various turtles, snakes, and insects, like dragonflies.

A SQUIRREL PLANTS AN ACORN-A SAPLING SPROUTS-OAK LEAVES PROVIDE MULCH.

3-INCH SAPLING HOLDS A ROBIN'S NEST.

14-INCH TRUNK-DEER JAYS-SQUIRRELS AND 'COONS FEED ON ACORNS.

AT MATURITY-HOLLOW SECTION IS 'COON DEN-FLICKERS DRILL IN DEAD LIMBS-ACORNS SPROUT NEW OAKS.

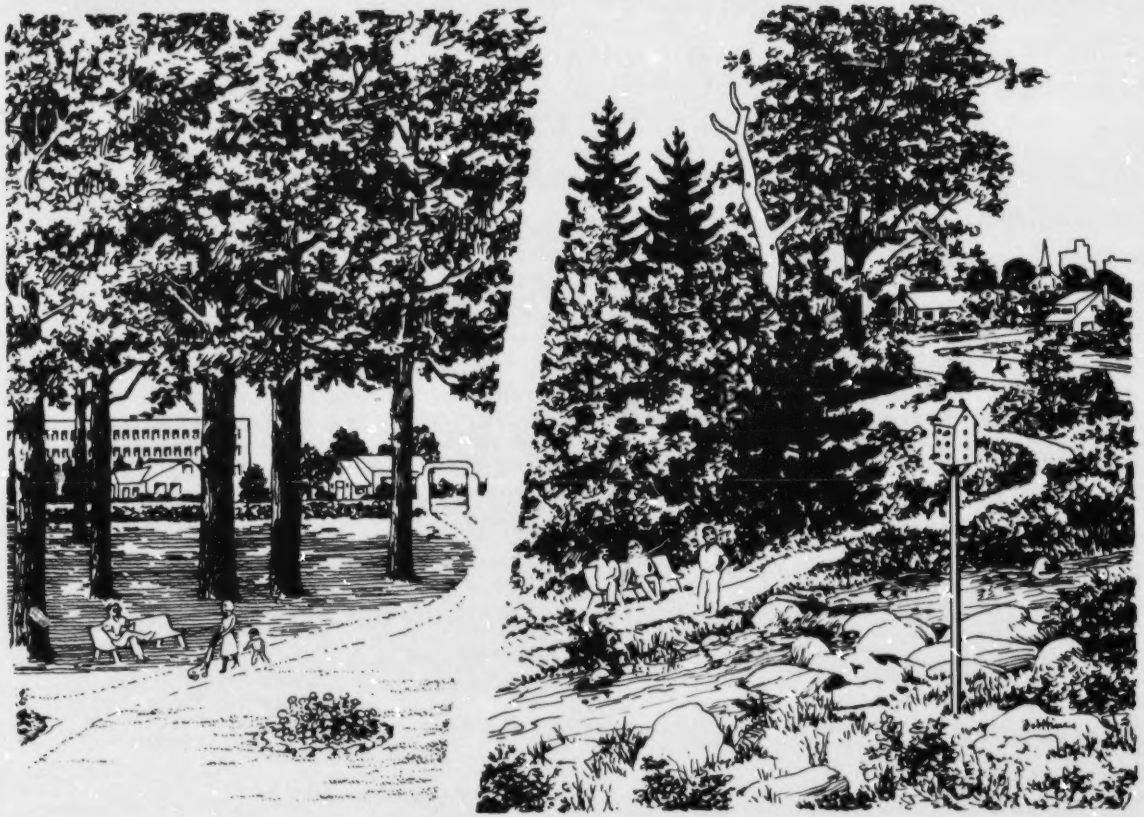
THE TREE DIES-ROTS-ENRICHES SOIL-TRUNK IS 'POSSUM DEN-ACORNS ASSURE ANOTHER GENERATION.

Many kinds of wildlife may be associated with a single oak tree during its life and death. The few interrelationships depicted here could be multiplied many times. In addition to cover, living space, and food in the form of acorns, many animals consume leaves and twigs, and a host of insects and other tiny animals are found on the foliage or in the bark or decaying wood of the tree. There are more large, mature trees in some urban areas than in the surrounding countryside. A dead limb on a tree, if it poses no danger to residents or passersby, adds to diversity of the wildlife habitat, as does a fallen tree in the process of decomposition.

While urban and suburban lawns with closely cut grass are frequented by robins in search of earthworms and other foods, taller vegetation, including flowers and shrubs in clumps or along yard borders, provides a more varied diet and offers more cover for wildlife. An area with plant diversity, where one type of vegetation mer es with another to create edge habitat, is likely to have more kinds of wildlife than one with a single type of cover.

This principle also applies to wooded areas like urban parks and forests. A forest with a mixture of broadleafed deciduous trees (trees such as oaks, maples, and beech that lose their leaves) and coniferous trees (like pines and spruce which remain green) is likely to have more wildlife species than a plantation of just one species. Also, a forest composed of uneven-aged trees, with different layers of vegetation above the forest floor, is suitable for many more wildlife species

Through a process called photosynthesis, green plants in the presence of sunlight, carbon dioxide, and water are able to create a form of sugar and other substances that support life. Plants are at the base of food chains, both in land and water habitats. On land, plant-eating animals like rabbits are eaten by predators like foxes. In water, algae serve as food for tiny crustaceans which are eaten by small fish, which in turn are eaten by larger fish, which perhaps fall prey to an osprey or bald eagle. Predation is a way of life. It helps regulate wildlife populations.



A park or wooded open space area consisting of mature deciduous trees with a ground cover of closely cropped grass has far less value for wildlife than an area with mixed deciduous and evergreen species of different ages and multiple layers of vegetation. Dead trees, snags, or limbs provide desirable diversity.

than is a city park characterized by tall trees and a mowed grass ground cover.

An assortment of insects, mites, and spiders is present on many forest floors. Beneath moist forest litter there may be earthworms fed upon by moles, shrews, and other animals. Birds like the Kentucky warbler and ovenbird nest on the forest floor.

The ground cover or herbaceous layer, consisting of ferns, mosses, grasses, and a variety of wildflowers, provides habitats for hermit thrushes, insects, box turtles, wood turtles, mice, snakes, toads, and many other animals.

The shrub layer differs according to locality and type of forest. Shrubs are woody plants with several stems and usually are no more than 15 to 20 feet tall. Dense coniferous forests with a mat of dead needles on the forest floor often have very little undergrowth. In open broadleaf forests where more sun reaches the ground, shrubs and vines may form a dense second crown canopy. In the Northeast, various viburnums, mountain laurel, winterberry, huckleberry, and blueberry are typical shrubs. Shrubs provide protective cover for a variety of small mammals and birds. Some songbirds, like rose-breasted grosbeaks and cardinals or "red birds", build their nests in shrubby thickets.

Above the shrub layer in many forests are small trees. These may be of the same kind that form the canopy, or of a different species like flowering dogwoods and hornbeams. Many songbirds nest in understory trees.

The main canopy is made up of the forest's tallest trees. It may be fairly open or closed, according to tree type and spacing. Open canopies permit more light to reach the layers below with the result that there are more vigorous shrubs and ground covers. Insects abound on the foliage of this canopy and here, warblers, vireos, flycatchers, scarlet tanagers, and other insect-eating birds often feed. Tree squirrels and porcupines also feed in the canopy.

Thus, food and cover are provided primarily by vegetation with predatory or meat-eating animals largely depending on plant eaters for food. Many animals, including foxes, robins, and bobwhite quail, eat both plant and animal matter. Ideally, for most kinds of wildlife, food, cover, and water should be located within a small area, i.e., close to each other. This saves energy and minimizes exposure to predators. In addition to vegetative cover, some animals find shelter in holes in the ground—perhaps dug by other animals—in rock piles or crevices, and in caves.

WATER

Wildlife species require water to live. Some water may be in the form of dew, but most birds and mammals get their water from ponds, creeks, lakes, and rivers, or from water accumulated in puddles after a rain or in tree cavities and crotches.

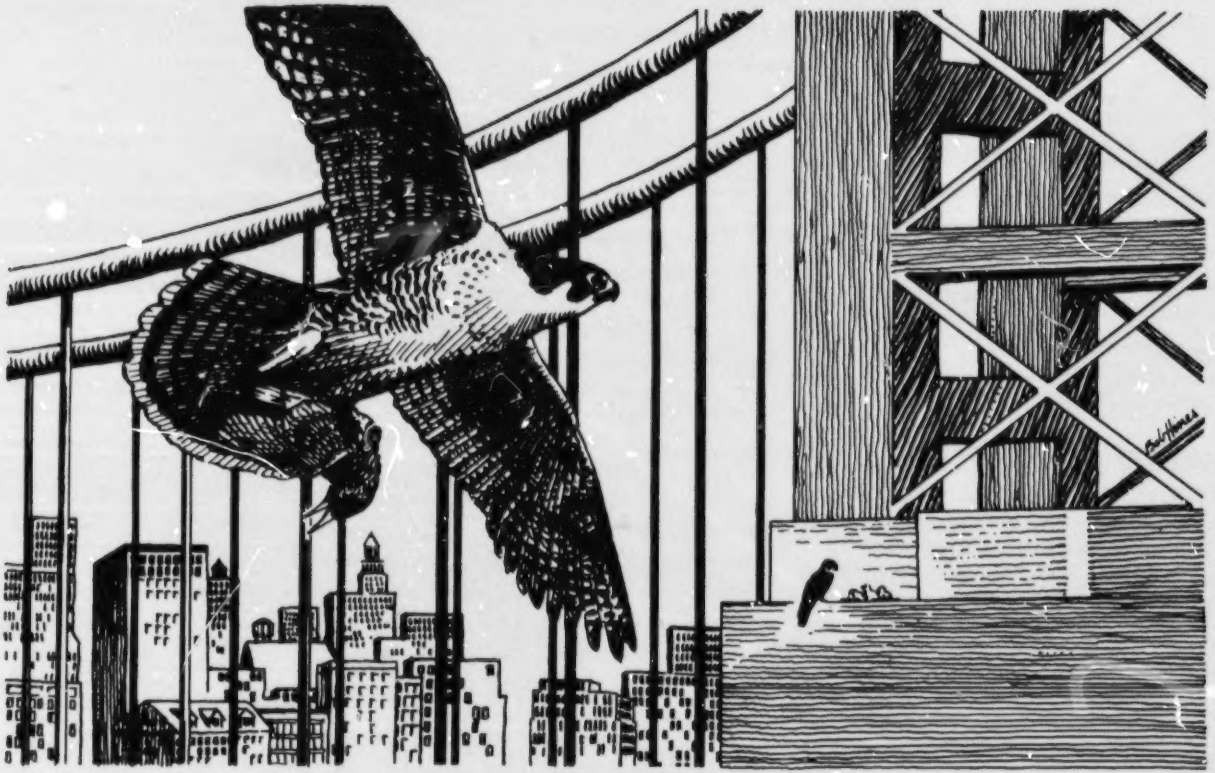
LIVING SPACE

Migratory birds which breed in one region and winter in another may travel hundreds or even thousands of miles in the course of a year. Foxes and hawks, in order to satisfy their food requirements, may have to hunt over relatively large areas. Many resident animals like cottontail rabbits, woodchucks, bobwhite quail, and house sparrows require little living space, if food, cover, and water are readily available.

MORTALITY FACTORS

Like humans, wild animals are subject to diseases, parasites, starvation (especially following heavy snow or ice storms), and accidental death. Predation is a natural process. In addition, hunters, trappers, and fishermen take some animals, but these activities are generally regulated so that the expected harvest of animals does not reduce next year's supply. The life span of most species is relatively short and the turn-over in many wildlife populations is rapid. This is true even in unhunted or unfished populations. Were it not for mortality, the world would soon be overflowing with wildlife. Only a tiny fraction of the eggs laid by a salmon or trout grow and survive to become adults.

Construction of rock- and concrete- or plastic-lined pools beneath a downspout of your house provides bird baths and drinking water for birds and other wildlife. Pools may be interconnected so that water is drained away from the house.



Man-made structures, including bridges in metropolitan areas, provide some habitat for wildlife. Here a peregrine falcon, an endangered species, is bringing a starling to its mate and fledglings at a nest on the ledge of a bridge support.

URBANIZATION EFFECTS

Urbanization affects living conditions for fish and wildlife in many ways. It influences the local environment, e.g., temperature and precipitation; it eliminates, alters, or creates new wildlife habitats; and it also affects wildlife directly, e.g., through death resulting from accidents on highways and streets and birds flying into glassed areas of buildings.

EFFECTS ON TEMPERATURE AND RAINFALL

Because of the heat-holding capabilities of pavement and massive concrete, brick, and stone construction, temperatures in the inner portions of large cities tend to be higher than in the surrounding suburbs and countryside. The temperature differences are enough that some landscape architects and horticulturists suggest using plant species that typically are suited for warmer and drier plant zones. Yet, tall buildings, under certain conditions, can funnel down drafts of cold air, adding to the discomfort of some winter days.

A study in the St. Louis, Missouri area revealed a pronounced increase in the occurrence of rains of one inch or more from storms passing across two urban industrial regions. The increased frequency of heavy storms was greatest in suburban areas downwind of major urban-industrial complexes--a finding that designers of stormwater ponds and sewer systems might wish to consider. Any changes in temperature and precipitation resulting from urbanization affect wildlife as well as humans.

EFFECTS ON VEGETATION

In new housing or industrial developments, including construction of streets and sewers, existing vegetation is usually removed. Trees 100 years or more old and 90 feet tall may be pushed over and uprooted by a bulldozer in a matter of seconds, later to be run through a woodchipping machine, shoved into a ravine and covered, or burned. Some trees may occasionally be sold for lumber. With a bit of extra care, trees near construction sites could be saved and still remain valuable to humans *and* wildlife.

With a bit of extra care, trees near construction sites could be saved and still remain valuable to humans and wildlife.

Landscapes are graded and smoothed and brushy areas are shifted to grass. Similarly, natural marsh vegetation may be eliminated in construction projects through filling or draining. Such destruction of vegetation destroys some wild animals directly and, more importantly, eliminates wildlife habitat.

In retaining existing trees, or planting trees for landscaping a fairly large lot, conifers on the north side of a house provide wind protection in winter. Deciduous trees on the south side afford shade in summer and allow the sun to heat the house in winter. This arrangement helps with heating and air conditioning bills and provides wildlife habitat at the same time.

With adequate planting and landscaping after construction of a housing development, some of the damage done can be offset. In time, especially where construction occurs on areas with scant vegetation, planted tracts may provide wildlife habitat superior to that existing before construction. In plantings, consideration should be given to species providing flowers, fruits, or nuts throughout as much of the year as possible.

EFFECTS ON SOIL AND WATER

Clearing vegetation and reshaping the land form results in greatly increased soil erosion and sedimentation which, in turn, affects the quality of water in the receiving streams, ponds, lakes, or estuaries. The sediment carried by runoff waters may cover spawning beds of fish, or harm fish and other aquatic organisms directly. During construction, lowlands and depressions

may also be covered or filled with gravel and soil. In undisturbed, vegetated areas, much of the water from rain soaks into the soil, some of it eventually seeping as ground water into nearby streams or lakes and helping to maintain a water level suitable for fish during dry summer periods.

With much of the ground in developed areas covered by buildings and pavement and some wetlands eliminated, stormwater runoff is rapid, and less water seeps into the soil. Compaction of the remaining soils is common. What were once free-flowing, meandering streams with populations of fish and other aquatic life, are often channelized, lined with concrete, or converted into enclosed stormwater lines providing little or no wildlife habitat. Recently, increased efforts have been made to retain urban runoff by means of various kinds of stormwater control basins. Some retention basins permanently maintained after construction have provided good fish and wildlife habitat, as have recreation lakes and water supply reservoirs.

Redevelopment projects in inner cities often are characterized by poor soil conditions resulting from removal of topsoil, soil compaction, pollutants, and bricks or other building materials and debris mixed in the soil. Proper disposal of these materials and care of the soil, including reuse of the topsoil, would greatly benefit wildlife habitat improvement projects.

POLLUTION

In addition to increased sedimentation, which is probably the major form of pollution, urbanization usually results in other forms of soil, water, noise, and air pollution. Particularly after heavy rains, large quantities of pesticides and fertilizers used on golf courses and lawns, and also oils, heavy metals, and other materials from streets and highways enter streams and other water bodies. Toxic materials may poison the water, while organic matter, as it decomposes, depletes the oxygen. Nutrients in the runoff often cause over-enrichment (eutrophication) of the waters resulting in unwanted algae growth. Auto exhaust fumes on highly traveled city streets may hasten the death of street trees, and lead deposits stemming from traffic may seriously affect the growth of lichens and other plants. Salt and other de-icing compounds used on city streets and highways are known to affect growth and survival of adjacent plants. Also, traffic noise from city beltways is sufficient to interfere with the enjoyment of birding in adjacent areas, and perhaps also with the singing and territorial defense systems of breeding birds themselves.

Concrete-lined ditches result in rapid runoff from the community on the right and have little value to fish and wildlife. In developing the community on the left, the natural stream and marsh were preserved. Water is retained between rains and excellent habitat is provided.

Small stormwater retention basins, if properly designed, can be retained following development of a new community and provide excellent wetland habitat with many of the same values of a recreation lake.

OTHER EFFECTS

In developed areas, buildings and other structures like bridges, overpasses, underpasses, and culverts associated with highways and streets; radio towers; electric power and telephone lines; and city and car lights become a part of the altered environment. These man-made components of wildlife habitat are beneficial to some species and detrimental to others.

Insecticides and fertilizers used on residential lawns, gardens, and golf courses eventually may be carried via streams and rivers to a bay or the ocean with degrading effects on the environment. Though retention or holding ponds in residential areas trap most of the sediment particles to which the chemicals are attached and carried, homeowners play an important role in preventing pollution. They should do everything they can to prevent erosion, follow the label on insecticide cartons, and avoid overfertilization of lawns and golf courses.

RESPONSE OF WILDLIFE TO URBANIZATION

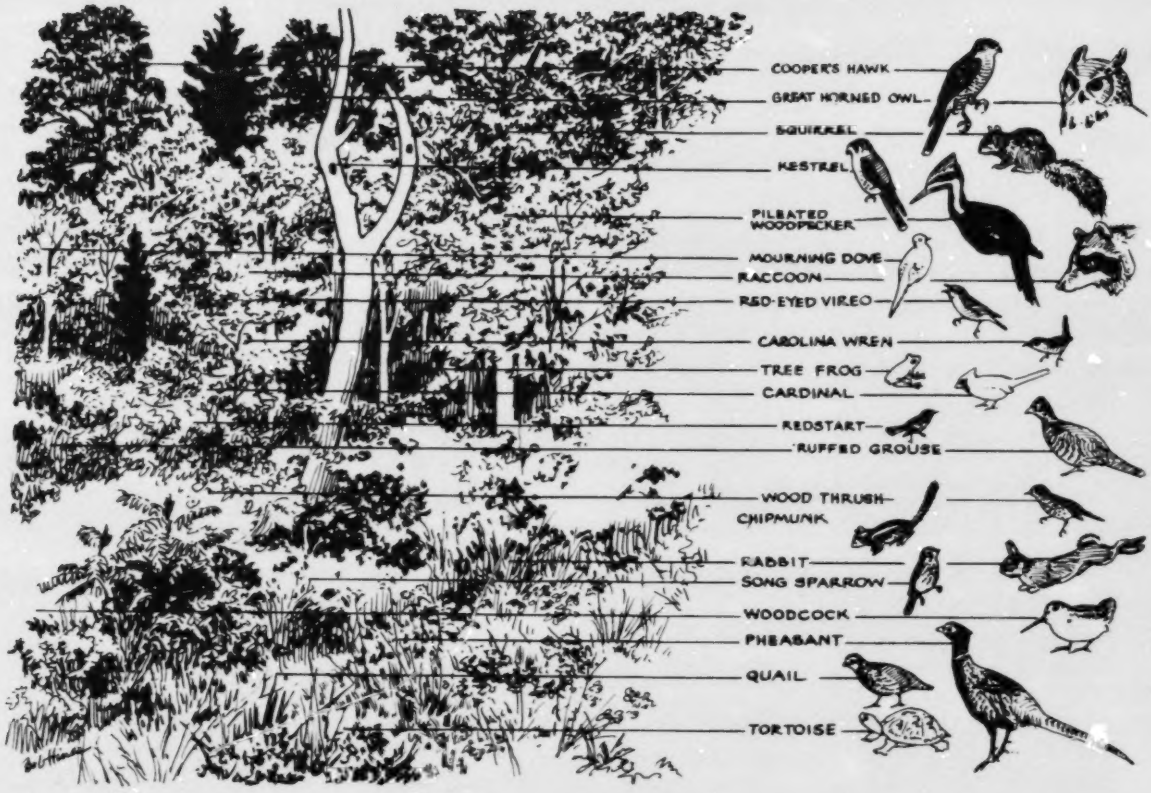
Because of the changed environmental and habitat conditions caused by urbanization, a wild animal must adapt to these conditions, leave the developed area, or die. Fortunately, many wildlife species are adaptable and can find a niche in developed areas where they can live and reproduce. Others are eliminated, especially from inner city areas. Recently studies have begun to show urbanization effects on, and responses of wildlife to, the changed conditions, and what can be done for urban-suburban wildlife through planning and management.

Such studies have been made in the development of the "new town" of Columbia, Maryland, midway between Washington, D.C. and Baltimore. Typical farmland species including the bobwhite and mourning dove declined sharply as Columbia developed on former crop fields and wooded tracts. Field-inhabiting species, like meadowlarks, red-winged blackbirds, and grasshopper sparrows; and woodland or woodland edge species like the wood thrush and indigo bunting, also declined as clearing and development proceeded. However, where remnants of the original forest floor were retained during development, and many trees and shrubs were used in landscaping, wood thrushes were retained in some areas and there were large increases in mockingbirds and song sparrows in others.

Washington, D.C.'s Rock Creek Park and New York City's Central Park are favorite birding areas. Over one quarter of the bird species inhabiting or regularly visiting the continental United States and Canada may be found in the course of a year within the Washington Beltway. National Wildlife Refuges, like Tinicum, on the outskirts of Philadelphia, and Great Meadow near Boston, abound with wildlife.

Population densities of tree squirrels in some urban-suburban areas, especially where urban forests or groups of large, mature trees have been preserved, may exceed those in non-urban areas. Raccoons are so abundant in some suburbs as to be a nuisance. Many other mammals — various mice, voles, moles, woodrats, chipmunks, rabbits, woodchucks, beaver, and even deer — are to be found in suburban and urban areas.

It is difficult to isolate effects of vegetation changes from other urbanization effects mentioned above. In Beach Haven West, Ocean City, New Jersey, development of coastal lagoon communities destroyed habitat for all species of waterfowl except the mallard duck, a species tolerant of urbanization and able to make use of unnatural food and cover available in



Wildlife habitat diversity, which is depicted here, results in a diversity of wildlife species. Not only is a mixture of deciduous and evergreen species important, but also vegetation at different levels, from the ground cover to the top canopy. Dead tree snags and limbs and fallen trees add to the diversity.

the development. Though a developed area may have less plant diversity and fewer bird species than the surrounding area, it may have a greater total population density and total bird biomass because of large populations of house sparrows, pigeons, and starlings which nest and roost on, in, or under man-made structures like buildings, bridges, and underpasses. A desirable species, the nighthawk, nests on the flat roofs of buildings.

Other habitat features of urban-suburban areas made use of by wildlife include telephone and power lines and poles, fences, artificial feeding stations, exposed garbage, openings to stormwater and (occasionally) sewer lines, and sewage treatment lagoons. Street lights and other outside lights attract many kinds of insects fed upon by bats, nighthawks, and toads.

Urbanization of Long Island in New York State resulted in a decline of many of the amphibians and reptiles native to that area. However, several species, like the red-backed salamander and Fowler's toad, were tolerant of the changed conditions; and some, like the painted turtle and the snapping turtle, probably benefited from artificial impoundments.

Box turtles, common in many urban-suburban areas are, like many other species, subject to highway traffic mortality. Also, the slow-moving box turtles are often picked up as pets by children and others who do not know how to care for them. Salamanders, although not often seen by suburbanites, are surprisingly abundant in some wooded areas and in or near spring-fed streams. They feed on invertebrates and may be fed on, in turn, by garter snakes, shrews, and some ground-feeding birds. Streams with unstable banks and little ground cover, loose and shifting stream bottoms, and other disturbances caused by urbanization support fewer salamanders, fish, and the animals on which they live.

If soil erosion and sedimentation and other forms of pollution can be controlled, natural lakes, ponds, rivers, streams, and marshes can be very productive of fish and wildlife; so can upland terrestrial areas. Urban residents can do much to preserve and manage existing areas productive of fish and wildlife; they can improve existing habitat; and they can create new habitat for the benefit of fish and wildlife and the public. The following sections deal with what can be done through planning and management to enhance conditions for urban-suburban wildlife and to realize more of the recreational and educational benefits it offers.

Urban residents can do much to preserve and manage existing areas productive of fish and wildlife.

WILDLIFE MANAGEMENT: PRINCIPLES AND APPROACHES

Wildlife management may be described as the actions taken to sustain wildlife populations, to enhance wildlife habitats, and to thus benefit both wildlife and people. Wildlife belongs to all people regardless of where it is produced or lives. The Federal Government (U.S. Department of the Interior and U.S. Department of Commerce) has primary responsibility for managing migratory birds, threatened and endangered species, and marine mammals and fish. The states have responsibility for managing resident fish and wildlife species. Wildlife management can be practiced most effectively, however, by those who own or control the land and water habitats.

PRINCIPLES

Wildlife management consists largely of providing the food, cover, water, and space needed for wildlife to live and reproduce. Merely protecting or preserving an area from development does not necessarily mean we have provided the greatest assist to wildlife. Although protection can be important, it is most difficult to keep the vegetation of an area in its current or most desired condition. Stringing a wire around an area and forbidding trespass may protect wildlife from human disturbance, but the vegetation undergoes constant change. Even though it may be presently ideal for a given wildlife species or community, this change may be detrimental to the selected species or wildlife community you wish to protect. Therefore, long-term vegetation management is needed.

Wildlife management can be practiced most effectively by those who own or control the land and water habitats.

In the Northeast, a brush area suitable for certain wildlife species, like ruffed grouse, will eventually evolve into a mature forest perhaps more suitable for squirrels and wild turkeys. A man-made reservoir productive of fish two or three years after construction may become unproductive after a few years because of sedimentation or other reasons. Management must be geared to the attitudes and goals of the landowner or the public, and to the requirements of the desired species or communities. It involves controlling or minimizing wildlife damage, health hazards, or nuisances as well as maximizing the positive values of wildlife for people. To reduce or eliminate wild-

life in a given area, one or more of the four factors essential for wildlife—food, water, cover, and living space—must be reduced or removed; to enhance conditions for wildlife, one or more of these factors should be enhanced, if they are limited.

APPROACHES TO WILDLIFE MANAGEMENT

Historically, the following approaches to wildlife management have been taken, singly or in combination.

1. Legislation and enforcement to: (a) provide protection for, or (b) regulate the harvest of certain wildlife species.

2. Establishment of refuges or sanctuaries to protect and provide wildlife with places to live and reproduce.

3. Predator control to reduce predation on: (a) certain wildlife species, and (b) livestock.

4. Artificial propagation at hatcheries or game farms of certain species of fish and wildlife for stocking selected areas.

5. Feeding of wildlife, especially during winter.

6. Erection of nest houses and structures for birds and squirrels, and artificial cover like brush and rock piles to supplement habitat management.

7. Habitat management, which in suburban-urban areas, in addition to vegetation management and water manipulation, involves special architectural designs, placement, and construction of buildings.

Some wildlife management approaches suitable for rural areas cannot be used in most metropolitan areas. Hunting, which serves as a method of animal population control, and controlled burning and livestock grazing, useful in vegetation control, are not generally permitted or feasible in urban areas. However, the following approaches may be applicable:

- Federal, state and local laws must be observed.
- Refuges or sanctuaries can be established for wildlife conservation and for providing opportunities for wildlife observation by the public.
- Ponds and lakes can be stocked with fish under the supervision of qualified fishery biologists.
- Artificial feeding of birds and wildlife, either by homeowners or as a community-sponsored project, can provide public enjoyment of the wildlife resource.
- Other artificial assists, like erecting bird houses and building shelters, can be given.
- Habitat management can be accomplished in suburban-urban areas.

A small pier on a stormwater retention basin increases opportunities for fishing and observing fish and wildlife. Railing provides a measure of protection against accidents.

HABITAT MANAGEMENT FOR FISH AND WILDLIFE

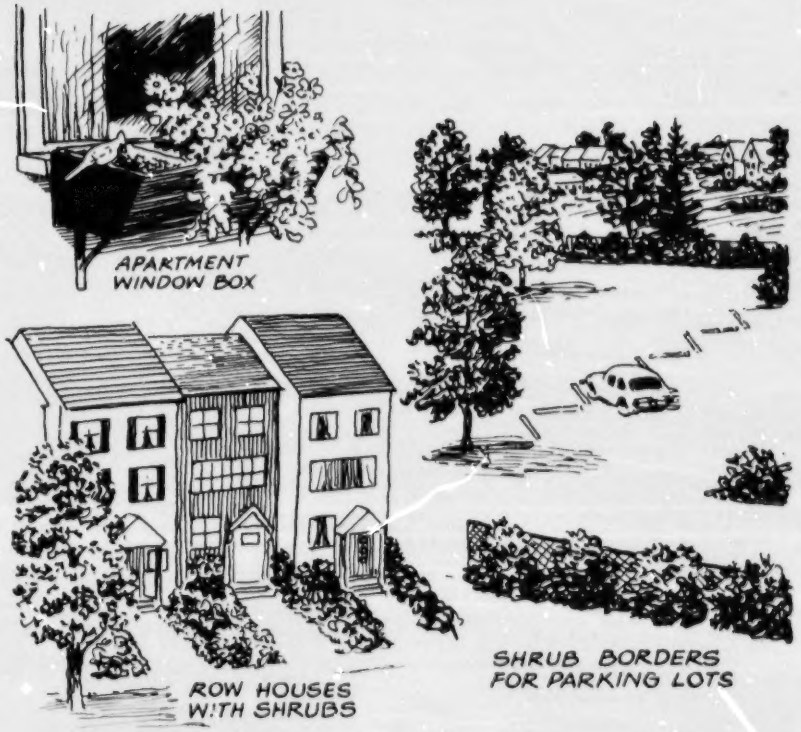
Habitat management is the most basic approach to wildlife management. Homeowners can contribute most to wildlife conservation through improved management of their own properties and by participating, along with apartment dwellers and others, in decision making related to environmental issues, both locally and nationally.

Habitat management is the most basic approach to wildlife management.

Considerations for wildlife should be included in planning before development begins. In this way, developers and builders can avoid destroying existing valuable habitat like wetlands or unique plant and animal communities and, perhaps in the process of development, they can actually improve

and diversify existing sites or create new wildlife habitat.

Planners and developers, along with landscape architects, help determine the type of habitat available after construction. While some civic organizations may have had input in the planning of new community developments, most citizens interested in suburban-urban wildlife management must, like wildlife managers in rural areas, work with the resources at hand. In addition to the yards of single family residences, there are opportunities for management in many other areas. These include parks, parkways, forests, community-owned lands, institutional grounds, cemeteries, golf courses, airport grounds, marshes, and free-flowing streams with wooded banks. All of these are often defined as "open space." Sand and gravel pits and quarries, lakes, ponds and reservoirs, city street trees, rights-of-way for highways, railroads and utility lines, and even



Street trees in residential areas, shrubbery adjacent to row houses and bordering parking lots, window box flowers, and even roof-top plantings on apartment buildings are frequented by various wildlife species.

balconies, rooftops, and courtyards of office and apartment complexes also offer management opportunities.

Some of the following actions might be considered by planners, developers, civic groups or interested individuals for enhancing urban-suburban wildlife habitat.

1. *With respect to vegetation:*

   - In construction projects, leave undisturbed as much as possible of the valuable native vegetation, particularly trees and shrubs. Native plant species are adapted to the area and often are more disease resistant and valuable to wildlife than exotics.
   - Retain or develop buffer strips of vegetation along free-flowing streams. These strips serve as travel lanes for wildlife and help control erosion and sedimentation.
   - In community and backyard landscape plantings, strive for a diversity of plant species with different flowering and fruiting seasons.
   - Consider less frequent mowing of extensive areas of turf, allowing taller flowering herbaceous plants to grow, particularly around the borders.
   - Underplant park-like areas characterized by tall trees and sparse ground cover such as closely clipped grass with clumps of shrubs. Shrubs and herbaceous species planted along woods borders also increase diversity and improve conditions for many species of wildlife.
   - Allow dead trees and trees with dead tops or limbs to remain standing if they do not pose danger to humans.

2. *With respect to soil management:*

   - Avoid construction projects on floodplains, whenever possible.
   - Avoid unnecessary erosion at construction sites by prompt seeding of grasses or construction of catchment basins.
   - Carefully remove the topsoil and replace it after construction is completed.
   - In reconstruction projects, bury trash, bricks and other building materials or remove them to a dump or other disposal site so they do not interfere with planting and other habitat improvement work.
   - Before final seeding or landscaping is undertaken, prepare the seed bed properly and use soil amendments (fertilizer and possibly lime). Follow the recommendations of the coun-

ty agricultural extension service or local land grant university, which can test soil samples and provide advice. Though some species survive on infertile soils, wildlife, like agricultural crops, is most productive on fertile soils.

- Consider using compost or sewage sludge to enrich and improve the soils. Homeowners can enrich their soil by using compost, decomposed leaves, wood chips or other materials. For larger community projects, sludge from sewage treatment plants may provide an inexpensive source of organic matter to improve suburban-urban soils.

3. *In connection with water management:*

- Preserve as many free-flowing streams as possible during development and insist on buffer strips of vegetation along them.

Fallen leaves and grass clippings may be used as mulch or as compost material in urban-suburban gardening. Further information on composting may be obtained from Dindal (1976) — see Suggested Readings and References.

- Protect sensitive areas from development so that wildlife values of natural ponds, lakes, or wetlands are not destroyed.

- Design, with the advice of qualified biologists, the shape of borrow pit ponds created in constructing urban-suburban parkways and highways, so the ponds will provide the best possible habitat for fish or wildlife.

- Similarly, explore the fish, wildlife, and recreational potentials of sand and gravel pits and quarries commonly found in urban-suburban areas. Some areas with known deposits of sand, gravel, or building stone can be held in reserve, and serve as wildlife refuges or sanctuaries prior to mining or housing-industrial development.

- Design stormwater control basins to be permanent and retain water after housing developments are completed. Such basins provide habitat for many fish and wildlife species and add to the enjoyment and wildlife appreciation of residents.

- Encourage the construction of recreation lakes and the use of water supply reservoirs for fishing and other recreational activities. Provide sources of clean water in your backyard.

MANAGEMENT TO PROMOTE EDUCATIONAL AND RECREATIONAL VALUES

The most convenient place for many homeowners to enjoy wildlife is their own backyard. When food, cover, and water are available, some wildlife is sure to be present. Planting flowers, attractive to colorful butterflies, and fruit-producing shrubs, valuable to many wildlife species, increases the variety of wildlife likely to live in, or visit the area. By establishing feeding stations near a house, you can see or photograph a large variety of birds. Very likely squirrels will come whether welcome or not, particularly during the winter months. Once begun, it is desirable to continue the feeding at least until late spring when flowers, buds, bugs, and other small animals are again available. Many people feed birds throughout the year. Inner city and apartment dwellers who do not have yards of their own can enjoy observing wildlife at community-sponsored feeding stations in nearby parks or other open space areas.

The most convenient place for many homeowners to enjoy wildlife is their own backyard.

A lake like this, shown only in part, aids in stormwater control; has aesthetic, recreational, and economic value; provides fish and wildlife habitat; and serves as a nature study area.

Observation blinds or towers located adjacent to marshes, rivers, or lakes where waterfowl or shorebirds concentrate, increase opportunities for wildlife appreciation. Development and maintenance of river walks and community fishing ponds add to peoples' enjoyment of fish and wildlife.

Well-designed nature trails through diverse habitats, and well-staffed nature centers with appropriate exhibits and educational facilities are very helpful in promoting wildlife conservation and environmental education. Participation of youth groups in conservation projects of 4-H Club and Boy and Girl Scout troops help educate both the youths and their parents so that they have greater appreciation for wildlife and ecology. Membership in chapters of the National Audubon Society, local bird clubs, nature photography groups, and civic organizations also is to be encouraged.

Children (and adults) should learn to know and appreciate wild animals as they are, not as portrayed in some cartoons as able to think and act like humans. Rather than catching and taking home as pets ducklings, box turtles, and baby robins, which have fallen out of their nest, the robins should be placed back in their nest and the ducklings and box turtles observed where they are to learn more about them. Raccoons acting tame and strangely should not be handled; they may be rabid and dangerous.

Children who grow up learning about wildlife only by looking at animated cartoons or comic strips in which animals are portrayed as thinking and acting like humans often form false impressions of what real animals are like. Children should have enough association with wildlife to recognize the animals as they really are, not as pets. They should be taught how to treat and deal with animals. Raccoons acting abnormally and seen about one's home in daytime, especially, should be left alone because they might be rabid. Box turtles found in a park or yard can be safely examined and studied, but they should not be taken home as pets. A robin, fallen from its nest and about ready to fly, should be gently placed back in its nest rather than taken home. A deer raised from a fawn by humans and released in a park may be tame enough to take food from a visitor's hand, but it should be remembered that full-grown deer can be dangerous. It is better to learn to appreciate wild animals as they are and for what they are — wild!

ANIMAL DAMAGE AND NUISANCE CONTROL CONSIDERATIONS

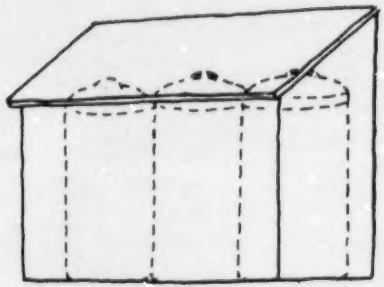
The approach for controlling those individual wild animals or wildlife populations causing property damage, concern for human health and safety, or nuisances differs from the habitat enhancement approaches previously described. Rather than trying to assure that adequate food, water, cover, and living space are available for the offending animals, an attempt is made to eliminate one or more of these life requirements so such animals are not attracted or will leave. Other approaches include preventing access to the property or crop, use of repellents, and removal of the animals. Some suggestions for dealing with, and minimizing problems caused by wildlife in urban and suburban areas, follow.

1. Design and construct buildings so as to avoid the presence of exposed beams, ledges, and unscreened eave ventilation holes, or other nooks, holes, and crannies likely to be occupied by unwanted house sparrows, starlings, and pigeons.

2. For buildings already constructed, screen such openings to prevent access by birds or squirrels.

3. Be sure that lids of garbage containers are tightly secured to prevent entry by raccoons, dogs, rats, or other unwelcome visitors.

4. Install substantial screening or other devices on chimneys to prevent access of raccoons, squirrels, and birds.



In addition to unleashed neighborhood dogs, raccoons are edept at getting into and upsetting trash cans containing garbage. Scattered contents of these cans are attractive to Norway rats. Lids of garbage cans should be securely fastened or the cans kept in raccoon-proof sheds.

5. In communities where squirrels damage newly planted flower bulbs, place a wire netting over the bulbs to prevent the squirrels from digging up the bulbs.

6. When deer are a problem, consider installing deer-proof fencing around the property. Screens or individual guards around young fruit trees prevent damage by rabbits.

7. Starlings which roost on the ledges of public and other buildings may be discouraged by using chemicals which give the birds the "hot foot."

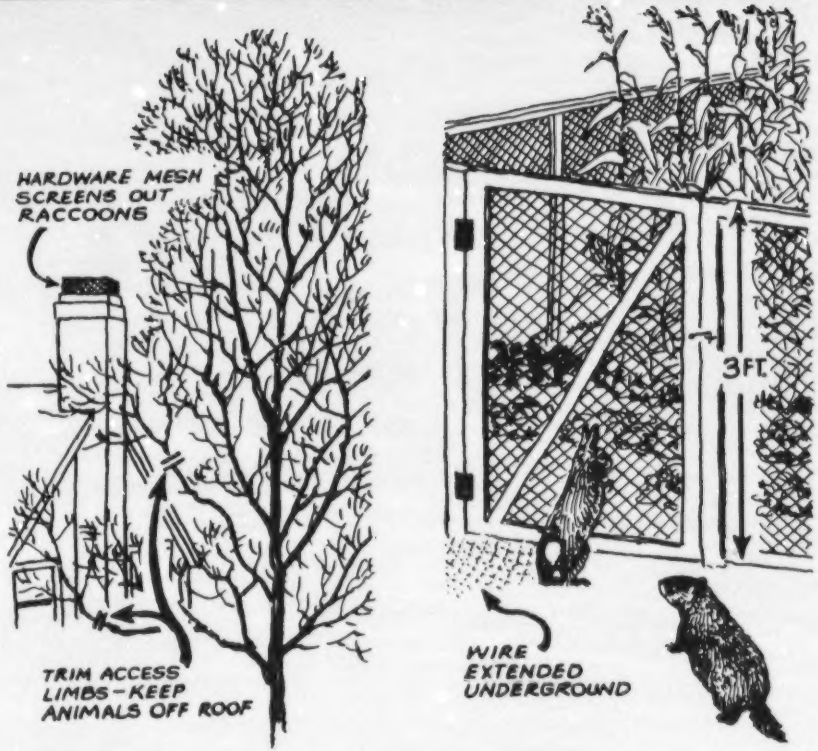
8. Large roosts of starlings, grackles, and blackbirds including those that cause pollution of water supply reservoirs may be reduced or eliminated by trimming or thinning of roost trees.

9. Ground moles which burrow under the surface of lawns can be removed by trapping. Various kinds of traps may be used for these and other offending animals.

10. In some situations, changes in plant type and date or depth of planting are helpful in reducing damage to vegetation. Your county agricultural agent may be able to give advice on this.

11. Squirrel interference with bird feeding can be reduced or eliminated by using counter-balanced or other available types of "squirrel-proof" feeders.

12. Trapping, poisoning, and killing animals, particularly game species, should be done only with legal authority. Homeowners are urged to contact county or state conservation officials before engaging in these activities. In the case of raccoons or other animals suspected of being rabid, the local health department may also be contacted. Often, a combination of control methods is most effective and, ideally, the approach should be safe, selective, effective, and humane.



Wild animal damage or nuisance control in urban and suburban areas can often be approached by excluding the animals from the crop or property by fences or screening, trapping the animals, or rendering the area unattractive through crop cultural or other changes affecting the habitat.

OTHER SUGGESTIONS FOR PROMOTING CONSERVATION AND ENHANCING WILDLIFE ENJOYMENT

In a guide of this size it is impossible to describe all of the things suburban and urban residents can do to enhance wildlife and to increase peoples' enjoyment of wildlife and related resources. Some actions already suggested may prompt readers to seek additional information by referring to some of the documents listed under Suggested Readings and References. Also, readers may wish to pursue some of the following suggestions.

1. Join community and civic associations and inform city and community planners and developers of your interests in wildlife conservation and in maintaining a high quality environment. Help with planning and decision making.

2. Help enact local ordinances for protecting, improving, or developing wildlife habitat and for governing land use in suburban and urban areas.

3. Get acquainted with fish and wildlife officials—federal, state, and local—charged with responsibility for managing fish and wildlife in your community so you will know where to turn for advice and assistance. The "Conservation Directory" published annually by the National Wildlife Federation provides a list of organizations, agencies, and officials concerned with natural resource use and management (see item 9, following).

4. Join national, state, and local wildlife conservation organizations and get on the mailing lists for their newsletters so you will be better informed on conservation issues.

5. Consult your local library, or selected government agencies, for information you may need.

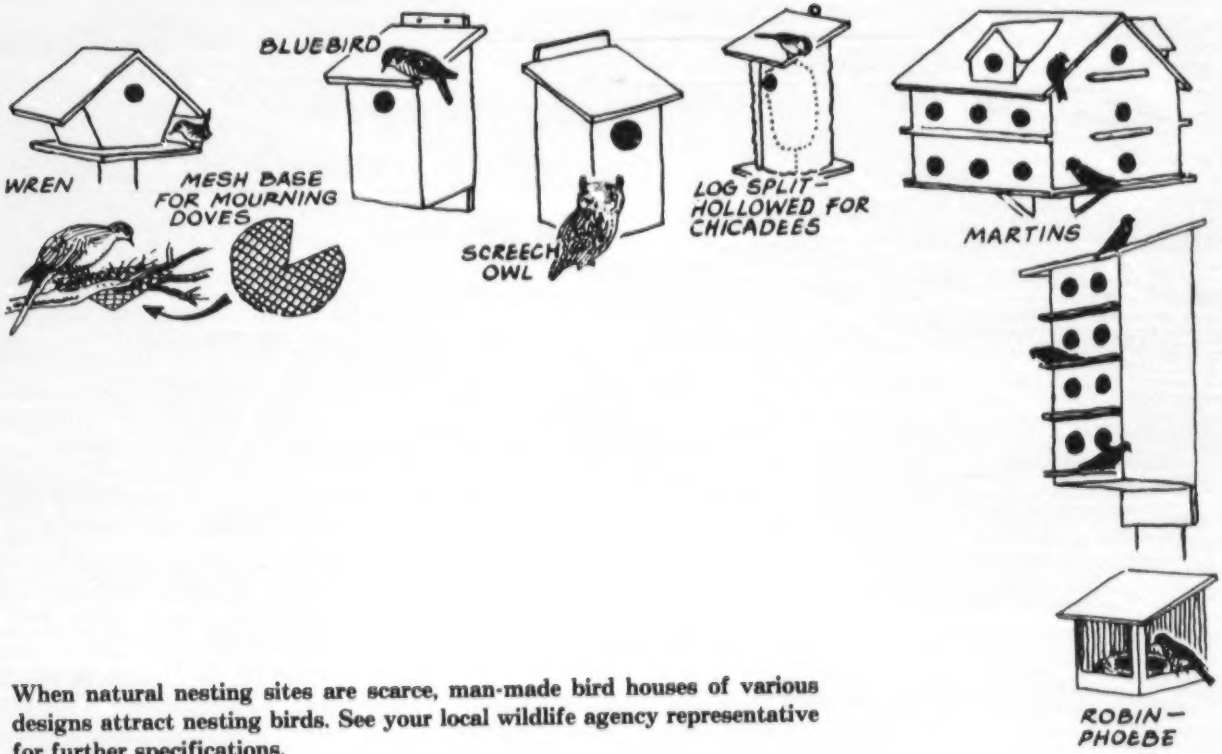
6. Encourage children to participate in wildlife conservation projects available, such as 4-H Club and Boy and Girl Scout programs.

7. Take advantage of the educational opportunities afforded by museums and nature centers and the guided tours or nature walks sponsored by local naturalist groups.

8. Select a hobby such as photography, or participate in continuing education courses dealing with flowers, or nature study.

9. Consider ways in which you can make your backyard more attractive to wildlife. The National Wildlife Federation, 1412 Sixteenth Street, N.W., Washington, D.C. 20036, and the National Institute for Urban Wildlife, 10921 Trotting Ridge Way, Columbia, Maryland 21044, have some information on this subject.

10. Explore possibilities for expanding or improving open space areas valuable for wildlife in your community.



When natural nesting sites are scarce, man-made bird houses of various designs attract nesting birds. See your local wildlife agency representative for further specifications.

Dimensions of nesting boxes for various species of birds that regularly use them, and the height at which they should be placed above the ground.

Species	Floor of Cavity	Depth of Cavity	Entrance above Floor	Diameter of Entrance	Height above Ground or Water(W)	Preferred Habitat Codes [4]
	Inches	Inches	Inches	Inches	Feet	
House Wren	4 × 4	6- 8	4- 6	1-1¼	4-10	2,7
Chickadees	4 × 4	9	7	1¼	4-15	2
Bewick's Wren	4 × 4	6- 8	4- 6	1¼	5-10	2,7
Titmouse	4 × 4	9	7	1¼	5-15	2
Downy Woodpecker	4 × 4	9	7	1¼	5-15	2
Prothonotary Warbler	4 × 4	6	4	1⅜	4-12,3W	3,5
Nuthatches [1]	4 × 4	9	7	1⅜	5-15	2
Carolina Wren	4 × 4	6- 8	4- 6	*1½	5-10	2,7
Bluebirds	4 × 4	8-12	6-10	*1½	3- 6	1
Tree Swallow	5 × 5	6- 8	4- 6	*1½	4-15	1
Violet-green Swallow	5 × 5	6- 8	4- 6	*1½	4-15	1
Ash-throated Flycatcher	6 × 6	8-10	6- 8	*1½	8-20	1,6
Hairy Woodpecker	6 × 6	12-15	9-12	1½	12-20	2
Great Crested Flycatcher	6 × 6	8-10	6- 8	1¾	8-20	1,2
Golden-fronted Woodpecker	6 × 6	12	9	2	10-20	2
Red-headed Woodpecker	6 × 6	12	9	2	10-20	2
Purple Martin	6 × 6	6	1	2¼	10-20	1
Saw-whet Owl	6 × 6	10-12	8-10	2½	12-20	2
Flicker	7 × 7	16-18	14-16	2½	6-30	1,2
Screech Owl	8 × 8	12-15	9-12	3	10-30	2
American Kestrel	8 × 8	12-15	9-12	3	10-30	1,4
Barn Owl	10 × 18	15-18	0- 4	6	12-18	4
Wood Duck	12 × 12	22	17	4	10-20,6W	3,5
Phoebe	6 × 6	6	[3]	[3]	8-12	7,8
Barn Swallow	6 × 6	6	[3]	[3]	8-12	7,8
Robin	6 × 8	8	[3]	[3]	6-15	7

*Precise measurement required, if diameter over 1-1/2 inches then starlings may usurp cavity.

[1]Brown-headed and Pygmy Nuthatches (1-1/8), Red-breasted Nuthatch (1-1/4) and White-breasted Nuthatch (1-3/8) will all use the same box. However, the smaller opening sizes where appropriate may discourage use by House Sparrows.

[3]One or more sides open.

[4]Preferred habitat codes. The numbers in the last column refer to the habitat types listed here:

1. Open areas in the sun (not shaded permanently by trees), pastures, fields, or golf courses.
2. Woodland clearings or the edge of woods.
3. Above water, or if on land, the entrance should face water.
4. On trunks of large tree, or high in little-frequented parts of barns, silos, water towers or church steeples.
5. Moist forest bottomlands, flooded river valleys, swamps.
6. Semi-arid country, deserts, dry open woods and wood edge.
7. Backyards, near buildings.
8. Near water; under bridges, barns.

Reprinted from Boone (1979).

SUGGESTED READINGS AND REFERENCES

Adams, L.W. L.E. Dove, and D.L. Leedy. In Press. Public attitudes toward urban wetlands for stormwater control and wildlife enhancement. Wildl. Soc. Bull.

Allen, D.L. 1954. Our Wildlife Legacy. Funk & Wagnalls Company, New York. 422 pp.

Boone, D. Daniel. 1979. Homes for Birds. Conservation Bulletin 14, revised edition. Department of the Interior, Fish and Wildlife Service. For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402. 22 pp.

Burger, G.V. 1973. (Later revisions available). Practical Wildlife Management. Winchester Press, 205 East 42nd Street, New York, NY 10017. 218 pp.

Burt, W.H., and R.P. Grossenheider. 1952. A Field Guide to the Mammals. Houghton Mifflin Company, Boston. 200 pp.

DeGraaf, R.M., and J.W. Thomas. 1973. Songbirds bring joy to cities. U.S.D.A. Forest Service, Northeastern Forest Experiment Sta., Forestry Service in the Service of Man, No. 16. 4 pp.

DeGraaf, R.M., and J.W. Thomas. 1974. A banquet for the birds. Natural History 83(1):40-45.

DeGraaf, R.M., and G.M. Witman. 1979. Trees, Shrubs, and Vines for Attracting Birds. A Manual for the Northeast. The University of Massachusetts Press, Amherst. 194 pp.

Dennis, J.V. 1978. A Complete Guide to Bird Feeding. Alfred A. Knopf, New York. 288 pp. + index.

Dindal, D.L. 1976. Ecology of compost: a public involvement project. State Univ. of N.Y., College of Environmental Science and Forestry, New York State Council of Environmental Advisers, Syracuse, N.Y. 12 pp.

Euler, D., F. Gilbert, and G. McKeating (eds.). 1975. Proceedings of the Symposium—Wildlife in Urban Canada. Office of Continuing Education, University of Guelph, Guelph, Ontario, and the Ontario Ministry of Natural Resources. 134 pp.

Geis, A.D. 1980. Relative attractiveness of different foods at wild bird feeders. U.S. Fish and Wildlife Service Special Scientific Report—Wildlife, #233. Washington, D.C.

Geist, V. 1975. Wildlife and people in an urban environment—the biology of cohabitation. Pages 36-47 *in* Euler, D., F. Gilbert, and G. McKeating (eds.). Proceedings of the Symposium—Wildlife in Urban Canada. Office of Continuing Educ., Univ. of Guelph, Guelph, Ontario and the Ontario Ministry of Natural Resources. 134 pp.

Harrison, G.H. 1979. The Back-Yard Bird Watcher. Simon and Schuster, New York. 284 pp.

Leedy, D.L., R.M. Maestro, and T.M. Franklin. 1978. Planning for

Wildlife in Cities and Suburbs. FWS/OBS-77/66, U.S. D.I. Fish and Wildlife Service, Washington, D.C. (U.S. Government Printing Office). 64 pp.

Leedy, D.L., T.M. Franklin, and R.M. Maestro. 1981. Planning for Urban Fishing and Waterfront Recreation. FWS/OBS-80/35, U.S.D.I. Fish and Wildlife Service, Washington, D.C. 20240. 108 pp.

McCormick, J. 1966. The Life of the Forest—Our living world of nature. Published in cooperation with the World Book Encyclopedia, McGraw-Hill Book Company, New York. 232 pp.

Noyes, J.H., and D.R. Progulske (eds.). 1974. A Symposium on Wildlife in an Urbanizing Environment. U.S.D.A. Coop. Ext. Service, Forest Service; Dept. of Forestry and Wildlife Mgmt., Univ. of Mass.; Mass. Coop. Wildlife Research Unit; Mass. Audubon Society; and The Wildlife Society. Planning and Resources Development Series, 28 Holdsworth Natural Resources Center, Univ. of Mass., Amherst. 128 pp.

Palmer, E.L., and H.S. Fowler. 1975. Field Book of Natural History (2nd edition). McGraw-Hill Book Company. New York. 779 pp.

Peterson, Roger T. 1980. A Field Guide to the Birds (4th edition). Houghton Mifflin Company, Boston. 384 pp.

Peterson, Roger T., and M. McKenny. 1968. A Field Guide to the Wildflowers of Northeastern and Northcentral North America. Houghton Mifflin Company, Boston. 420 pp.

Pyle, R.M. 1981. The Audubon Society Field Guide to North American Butterflies. Alfred A. Knopf, New York. 915 pp.

Schlauch, F.C. 1976. City snakes, suburban salamanders. Natural History 85(5):46-53.

Terres, J.K. 1980. The Audubon Society Encyclopedia of North American Birds. Alfred A. Knopf, New York. 1109 pp.

U.S. Department of the Interior and U.S. Department of Commerce. 1982. 1980 National Survey of Fishing, Hunting and Wildlife-Associated Recreation. U.S. Government Printing Office, Washington, D.C. 20402. 156 pp.

Viertel, A.T. 1959. Trees, Shrubs and Vines—a pictorial guide to the ornamental woody plants of the Northeastern United States exclusive of conifers. State University College of Forestry at Syracuse University. (Pages unnumbered.)

Vogt, B. 1978. How to Build a Better Outdoors. David McKay Company, Inc., New York. 149 pp.

The mission of the National Institute for Urban Wildlife is to be a responsible and effective scientific and educational organization advocating the enhancement of urban wildlife values and habitat, and the wise use of all natural resources for the benefit of people in cities, suburbs, and developing areas.

The Institute accomplishes its mission by: (1) conducting sound research on the relationships between man and wildlife under urban and urbanizing conditions; (2) discovering and disseminating practical procedures for maintaining and enhancing wildlife populations, and controlling certain wildlife species in urban areas; (3) building an appreciation for, and an understanding of, wildlife and wildlife needs; (4) establishing a positive conservation ethic through education programs directed at the community and neighborhood levels; and (5) illustrating how all segments of our people have a vested interest in wildlife and the environment we mutually share.